Seasonality and distributions of macro-algae *Sargassum* beds at Point Peron, Shoalwater Islands Marine Park, Western Australia *

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Sargassum C. Agardh is one of the most diverse genera of the marine macro-algae, is distributed worldwide, and is mainly dominant in tropical and sub-tropical shallow waters. There are about 46 *Sargassum* species found along the Western Australia (WA) coast (Herbarium 2013), with the large majority of studies on WA's macro-algae focusing on taxonomic and molecular works (e.g. Kendrick & Walker 1994; Goldberg & Huisman 2004; Dixon *et al.* 2012; Kendrick *et al.* 2012). A number of other studies have focused on seaweed physiology including green macroalgae (De Clerck *et al.* 2008) and red macro-algae (Huisman *et al.* 2009; Muñoz & Fotedar 2011). Up to date, there are a limited number of studies on seasonal variation on *Sargassum* communities that have been undertaken along the subtropical/temperate coastal zone of WA (Kendrick 1993; Kendrick & Walker 1994).

This study was carried out to investigate the seasonality of water qualities, canopy cover, thallus length and distribution of *Sargassum* beds around Point Peron, Shoalwater Islands Marine Park, WA. The aim was to improve our understanding of the seasonal abundance and distribution of *Sargassum* and the effects of water quality parameters on their biomass. Here we measured the seasonal variation in physico-chemical water parameters alongside changes in mean thallus length, density and total biomass of *Sargassum* and determined how this impacts the broader spatial distribution of *Sargassum* beds using *in-situ* observations and remote sensing methods.

The data on canopy cover, thallus length and distribution patterns were collected every three months from 2012 to 2014 at four different reef zones along monitored transects. Sampling was carrried out by either scuba or free diving techniques. Along these monitoring transects, a total of three sites were randomly selected within the lagoon, back reef, reef crest and fore reef zones. Measurements of fresh biomass, cover percentage, and thallus length were made by deploying 0.25 m^2 quadrats (0.5 x 0.5 metre), with a total of 12 tagged quadrat sites established. The tagged quadrats' locations were recorded with a hand held GPS (Garmin Etrex 10) for storage and easy renavigating during the following sampling season. *Sargassum* spp. within each quadrat were collected, stored in labelled plastic bags and carried to Curtin Aquatic Research Laboratory, Curtin University, WA for futher analysis and experiments. Meteorological data such as maximum, mean and minimum air temperature, monthly rainfall and monthly solar exposure for each season were acquired from the Garden Island HSF weather station, two kilometres north of Point Peron, Bureau of Meteorology, Australian Government (http://www.bom.gov.au/climate/data/). Euphotic depth, Coloured Dissolved Organic Matter (CDOM), Photosynthetically Available Radiation (PAR), Sea surface temperatures (SSTs), Sea level pressure, and Chlorophyll-a concentration (Chl-a) in the study area were extracted from the Moderate Resolution Imaging Spectroradiometer (MODIS) satellite data (Acker & Leptoukh 2007). Dissolved oxygen, salinity, *p*H, conductivity of seawater were *in-situ* measured from the field (YSI®55, Perth Scientific). Five seawater samples were collected for analysis of nutrients concentration including nitrate, nitrite, ammonia, and phosphate for each sampling season. High spatial resolution satellite images WorldView-2 with 2 m spatial resolution was acquired on February 7th 2013 (austral summer) and, along with the period of highest biomass of *Sargassum* beds, was used to estimate the spatial distribution pattern of *Sargassum*.

The results showed that the *Sargassum* beds in Point Peron showed remarkable seasonal changes in canopy cover and thallus length. There was a significant difference in *Sargassum* canopy cover between seasons. However, there were no significant differences between the reef zones. Results also show that the *Sargassum* spp. community demonstrated a seasonal variation pattern of coverage and mean thallus length which is significantly influenced by the nutrient concentrations (PO_4^{3-}), sun radiation, collecting zone, and collecting season ($P < 0.05$). There are many different physical, chemical and biological parameters that affect the *Sargassum* community. They might contribute to optimum conditions for *Sargassum* growth as well as limitation factors such as the effect of water temperature, radiation and rainfall on *Sargassum* canopy cover, thallus length and distribution; the interaction of the *Sargassum* communities on water quality and vice versa; the effect of geographical zone (reef zones) on water quality; the variation of water temperature, radiation and rainfall at different geographical zones (study sites); the effect of air temperature, radiation and rainfall factors on water qualities and the season's conditions; and the seasons also driving changing water qualities and influencing *Sargassum* growth. In this study, we were evaluating the effect of environment parameters on *Sargassum* cover; the effect of sea surface temperature on *Sargassum* community and the relationship between nutrient

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concentration and *Sargassum* thallus length. However, the understanding of how *Sargassum* communities affect water quality and differences in water qualities at different geographical areas has not been examined in this study yet.

In summary, the present study presents first hand baseline information on the effect of seasons on canopy cover and mean length thallus of *Sargassum* species at the different reef zones. Results show that the *Sargassum* spp. community demonstrated a seasonal variation pattern in coverage and mean thallus length which is significantly influenced by the nutrient concentrations (PO_4^{3-}), sun radiation, collecting zone, and collecting season ($P < 0.05$). This study demonstrates primary and novel information on *Sargassum* beds' structure of Point Peron by using a combination of *in-situ* and satellite remote sensing observations. These detailed data might provide necessary information for coastal marine management and conservation as well as sustainable utilisation of this renewable marine resource. The methods can also be applied as a bio-monitoring programme for *Sargassum* beds along the WA coast and in other potential regions.

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